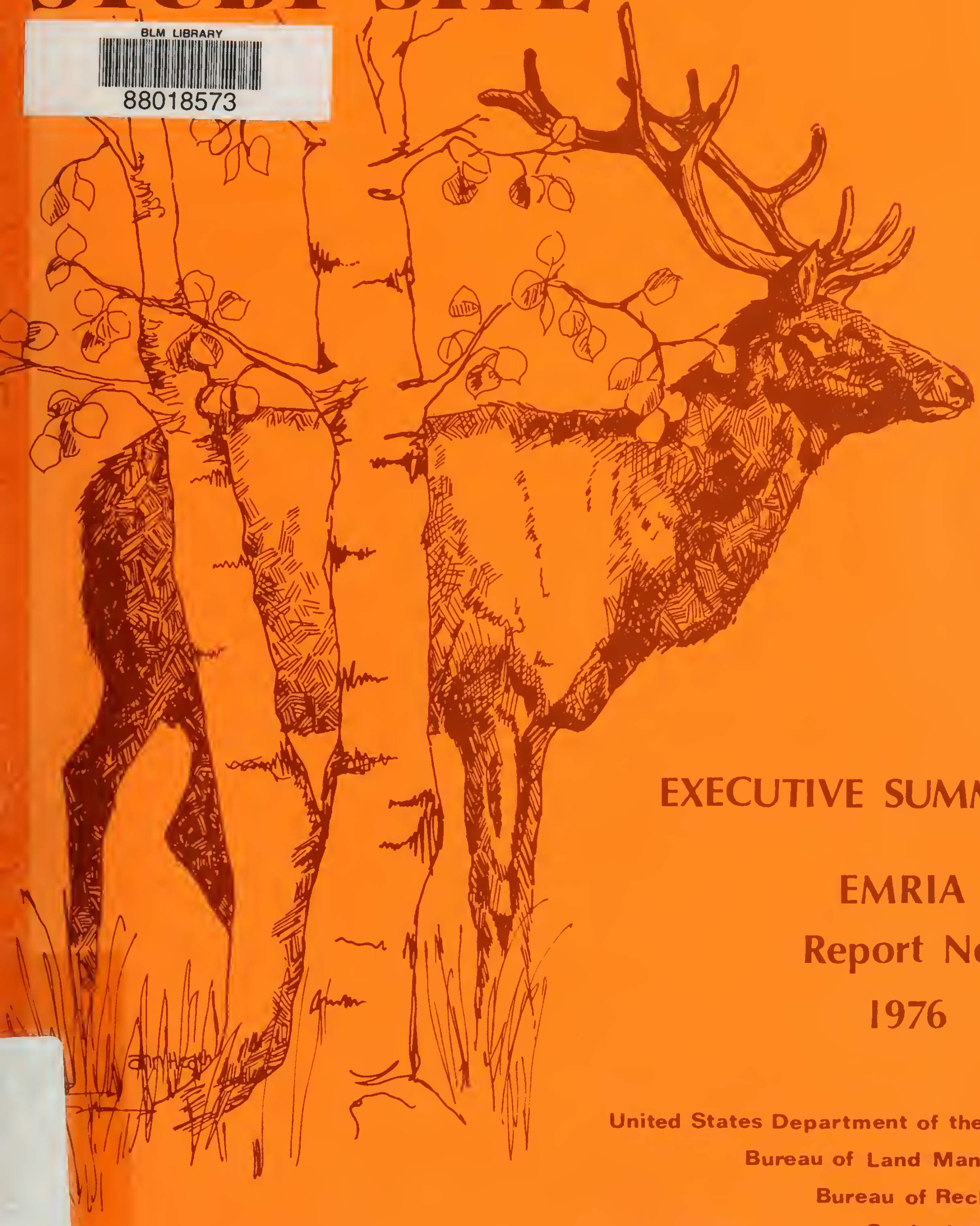
Resource & Potential Reclamation Evaluation

FOIDEL CREEK STUDY SITE

BLM LIBRARY
88018573



EXECUTIVE SUMMARY

EMRIA

Report No. 6

1976

United States Department of the Interior
Bureau of Land Management
Bureau of Reclamation
Geological Survey

BUREAU OF LAND MANAGEMENT
Library
Denver Service Center

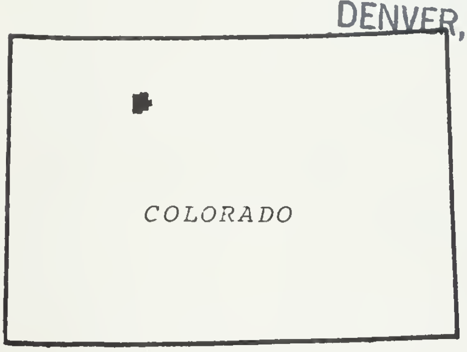
7189686
ID88018573

TD
195
.S75
E47
no.6
c.2

RESOURCE AND POTENTIAL RECLAMATION EVALUATION

FOIDEL CREEK
STUDY SITE

BLM LIBRARY
SC-324A, BLDG. 50
DENVER FEDERAL CENTER
P. O. BOX 25047
DENVER, CO 80225-0047



EMRIA Report No. 6

Prepared by:

Bureau of Land Management
Bureau of Reclamation
Geological Survey
of the
United States Department of the Interior

(published September 1979)

BUREAU OF LAND MANAGEMENT
Library
Denver Service Center

FOIDEL CREEK STUDY AREA

LOCATION & MINERAL STATUS

FIGURE 1

PURPOSE

The purpose of this study was to describe the basic resources on the Foidel Creek Study Site, determine the reclamation potential, identify problems involved in reclamation, and recommend measures required to meet the reclamation objectives for the area. The reclamation objective will be to reclaim the area after mining to its present uses of wildlife grazing and habitat, domestic livestock grazing, and watershed management.

SITE DESCRIPTION

The study site lands are located approximately 25 miles southwest of Steamboat Springs, Colorado. The lands lie within Routt County and are described as follows:

T. 4 N., R. 87 W.	T. 4 N., R. 86 W.
Section 13: all	Section 18: all, except E1/2E1/2
Section 24: all	Section 19: all, except E1/2SE1/4 and the E1/2W1/2SE1/4

The surface ownership is private (held mostly by mining companies) but the coal minerals are owned by the Federal Government and administered by the Bureau of Land Management.

Colorado State Highway No. 131 is approximately 6 miles east of the study site and the communities of Craig, Hayden, and Steamboat Springs are located north along U.S. Highway No. 40.

The study site lies at an elevation between 7000 and 8080 feet. Foidel Creek is the major drainage in the area.

RESOURCE SUMMARIES

Geology and Coal Resources

The study site lies on the side of a northward dipping monocline. Dips on the slope seldom exceed 15°. All rocks present within the study site belong to two formations, the Williams Fork and the Iles, both of which belong to the Mesa Verde group. The Lewis shale lies just a very short distance to the north of the study site. The Wadge bed lies within the Williams Fork Formation and is the unit that will be mined if the area is leased for coal development. The Wadge and Wolf Creek coalbeds in the Foidel Creek Study Site make up the middle coal group of the Yampa Coal Field. The coal resources of the lower and upper coal groups of the Yampa Coal Field, which are also present in the area, were not studied. Although it reaches thicknesses of 18.5 feet, the Wolf Creek bed is highly irregular in thickness and locally contains thick partings of claystone. It was penetrated by EMRIA (Energy Mineral Rehabilitation Inventory and Analysis) deep holes 1 and 2 and by two holes drilled by the Energy Fuels Corporation in the area just east of the Foidel Creek Study Site. The maximum thickness of the Wolf Creek bed encountered during the EMRIA drilling was 18.9 feet and the minimum was 3.7 feet. The Wolf Creek bed is not now being mined in the Foidel Creek area. The Wadge coalbed, which lies above the Wolf Creek bed, is the most uniform in thickness of the coalbeds in the middle coal group and has been mined and prospected at numerous localities; it has an average thickness of 8.5 feet, and attains a maximum reported thickness of 12.2 feet. The Wadge bed is presently being mined at the Energy Fuels Corporation's Energy Strip No. 1 mine (thickness 8.2 feet), just east of the Foidel Creek Study Site, and at the Pittsburgh and Midway Coal Mining Company's Edna mine (thickness 5.5 feet). The Lennox coalbed has also been mined at the Edna mine where it is 3.7 to 4.6 feet thick. The Lennox bed cannot be recognized with certainty in drill holes within the Foidel Creek area. A number of lenticular coalbeds ranging from 1.5 to about 5.5 feet in thickness have been encountered at approximately the stratigraphic level of the Lennox bed.

Coal resources of the Wolf Creek and Wadge beds have been calculated for the Foidel Creek Study Site. Because of their lenticularity, coalbeds at the stratigraphic level of the Lennox bed have not been considered in this analysis. The Wolf Creek bed is estimated to contain 49.7 million metric tons of coal. Of this amount, only about 11.8 million metric tons occur beneath overburden of 186 feet or less. The Wadge bed contains approximately 36.1 million metric tons of coal. Of this amount, 28.1 million metric tons occurs beneath an overburden thickness of 186 feet or less. The Wolf Creek, Wadge, and Lennox coalbeds of the middle coal group are all classified as high-volatile C bituminous in rank. Four analyses of Wolf Creek coal averaged 9.2 percent moisture, 34.1 percent volatile matter, 44.1 percent fixed carbon, 12.6 percent ash with 0.6 percent sulfur, and had a heating value of 10,530 Btu's. The five analyses of Wadge coal from the Foidel Creek Study Site averaged 10.8 percent moisture, 32.6 percent volatile matter, 43.0 percent fixed carbon, and 13.6 percent ash with 1.0 percent sulfur and had a heating value of 10,080 Btu's. The average value of 1.0 percent sulfur in samples of Wadge coal collected from the EMRIA core holes is not representative of the Wadge coalbed in this area, but reflects the high sulfur content of one of the samples. The other four samples contained 0.5 percent or less of sulfur. Also, the relatively high ash content of the samples of Wadge coal from the study site cannot, therefore, be considered representative of the Wadge coal elsewhere in the Foidel Creek area. The major, minor, and trace elemental compositions of the Foidel Creek area samples are typical of coal in the Rocky Mountain Province, all values falling well within the ranges of values reported for the province.

Overburden, Soils, and Land Classification

A detailed land suitability survey was made of the study area. Its purpose was to characterize and evaluate the surface and upper 5 feet of soils in relation to its suitability as a source of planting media for resurfacing shaped spoils following surface mining. This survey provides data on the quality and quantity of surface material in relation to revegetation and ease of stripping. Land classification specifications to establish ranges of land suitability as a source of planting media were developed specifically for the site. Factors included in the specifications for consideration were: texture, salinity sodicity, permeability, available water holding capacity, and erodability. The depth of suitable material was also noted. The land suitability survey shows that approximately 91 percent of the study area has adequate soil material for postmining reclamation purposes.

Three major soil bodies are generally recognized within the Foidel Creek Study Site. Parent material and topographic position are the primary factors used in this categorization. These major soil bodies are designated as: (1) Soils which are forming on sandstones occupying sloping to strongly sloping mountain foothills; (2) soils occurring on the shaley formations which occupy gently sloping to sloping, smoothly rounded uplands, and are generally located below or at lower elevations than the soils described in (1); and (3) alluvial soils of mixed origin which occupy the principal stream valleys.

Soils occurring on the sandstone member are generally coarse in texture but have moderately high water holding capacities. Structurally, these soils are not very stable when disturbance occurs even though they are quite stable in situ. These soils are moderately deep to deep ranging from about 30 to over 60 inches in depth. The pH values range from 5.6 to 6.7. Based on their chemical and physical properties, these soils are highly suited as a source of plant growth medium.

Soils occurring on the shaley formations in the south ard west part of the study site are fine textured being generally heavy clay loams to clays that have high available water holding capacities. Permeabilities of these soils are generally very slow due to their heavy texture and poor physical condition. However, these soils are quite stable and should withstand a considerable amount of physical disturbance. Depth of these soils generally ranges from 18 to 40 inches over consolidated or slightly weathered shales and sandstones but can be considerably shallower in steeper highly eroded areas. The pH values range from 6.1 to 7.3. These soils have a fair suitability for use as a planting media with the major limiting factor being the soil-water relationships due to the fine textures.

The alluvial soils of the principal stream valleys vary widely in their physical characteristics. These variations are primarily the result of the origin of parent materials present in the different alluvial areas as well as the depth of alluvial deposition within the valleys. The soils in the valley of the North Fork of Middle Creek have moderately high available water holding capacities and moderately slow permeabilities. These soils have a fair suitability for use as planting media. The soils of Foidel Creek Valley and its major tributary within the study site have a high water holding capacity and a slow rate of permeability. Structurally, these soils are relatively weak due to the recent nature of parent material deposition. These soils are poorly suited as planting media because of the heavy textures, resulting in slow permeabilities and infiltration rates.

Overburden taken from a depth of 5 feet to the bottom of the coal seam was evaluated in terms of its use as a planting medium. The overburden was evaluated only on the basis of the five deep holes drilled on the study site. Approximately 67 percent of the overburden is rated as suitable for use as planting media. However, wherever suitable topsoil exists in sufficient quantities, it should be stockpiled and utilized as top priority plant growing material.

Toxic elements studied in the overburden materials were limited to sodium, chloride, and sulfate salts. These elements, which can be toxic in high concentrations to plant growth, are not of the magnitude to be toxic in the materials rated as suitable; however, more detailed studies conducted by the lessee prior to mining may reveal other toxic elements unfavorable for plant growth. In addition to the overburden testing program, greenhouse pot studies were made on selected samples to indicate possible toxic or other unfavorable plant growth conditions. The additional data from the greenhouse pot studies were used in evaluating the overburden materials.

Climate and Hydrology

Annual precipitation on the study area varies between 16 inches for lower elevations and 20 to 25 inches at the higher elevations. It is estimated that 90 days per year precipitation is greater than the detectable limit of 0.01 inch for the area. Growing season is expected to be approximately 60 to 70 days. Under normal climate conditions there appear to be no climatic limitations to reclamation on the Foidel Creek Study Site. However, the evapotranspiration demand is high at all elevations on the study site, and this may limit revegetation attempts to spring and fall.

Two principal stream systems cross the Foidel Creek Study Site. These are Foidel Creek and North Fork of Middle Creek. Stream discharges for water years 1976 through 1978 were evaluated. The average discharge for Middle Creek near Oak Creek, Colorado, with a drainage area of 23 square miles, was 2 cubic feet per second. The average discharge for Foidel Creek with a drainage area of 8.6 square miles near Oak Creek, Colorado, was 0.3 cubic foot per second. The average discharge for Foidel Creek with a drainage area of 17.5 square miles at its mouth near Oak Creek, Colorado, was 1.2 cubic feet per second. Extremely low discharges for the water year 1977 were experienced and are a reflection of the drought of that year. Both Foidel Creek and the North Fork of Middle Creek are intermittent streams in the study site. They are snowmelt-dominated streams, in that most of their runoff occurs in the spring in response to snowmelt. Floods may occur as a result of melting snowpack in the spring or as a result of convective-type cloudburst storms from late spring through fall, or a combination of both. The flooding within the study site is limited to the immediate channel areas. The 100-year flood discharge for North Fork of Middle Creek is estimated to be 98 cubic feet per second. The 100-year discharge for Foidel Creek at the downstream end of the study site is estimated to be 130 cubic feet per second.

Within the boundaries of the Foidel Creek Study Site there is currently no withdrawal from the ground-water system except by natural discharge of groundwater to Foidel Creek under the prevailing gaining conditions. Recharge to the rock units within the Foidel Creek Study Site results from infiltration of precipitation and snowmelt. The amount of recharge is not known but it is probably less than 1 percent of the annual precipitation. There is some recharge to the alluvium during periods of high discharge in Foidel Creek. This water, however, is immediately released as the stage decreases. Small stock ponds within the study site probably do not contribute to recharge because of the high evaporation rates and silting and sealing of the pond bottoms. A discharge of about 10 gallons per minute for a small diameter well is probably the maximum for wells in this area.

Water quality samples from Foidel Creek collected from March 1976 through June 1978 were analyzed for major ions and selected trace constituents. The average concentrations for calcium, magnesium, sodium, potassium, bicarbonate, sulfate, and chloride meet promulgated standards for both aquatic live and domestic drinking water supplies as given by the Environmental Protection Agency. Suspended sediment concentrations based on periodic sampling were low to moderate. The bed and banks of the Foidel Creek channel consist primarily of silts and clays and the valley in which this stream flows is primarily fine grained material. Disruptions near the channel could, therefore, increase suspended sediment concentrations dramatically. Once in suspension, this fine-grained material can travel great distances downstream.

Vegetation

Five vegetative types are found within the study site: broad-leafed trees, mountain shrub, sagebrush, grass, and meadow. The vegetation of the study site was mapped by vegetative subtypes which are described in the following table. Generally, the subtypes can be (grown) found on the soils described in the table across from each subtype.

Vegetative types	Subtype	Soils
Broad-leafed trees	Aspen - occupying north facing slopes.	Loam to fine sandy loam. Approximate depth 14 to 18 inches.
Mountain shrub	Gambel Oak and Snowberry - occupying the rock outcrops on south aspects.	Loam to fine sandy loam. Approximate depth 6 to 12 inches.
	Snowberry - Gambel's Oak - occupying the steep lower north aspects.	Loam to fine sandy loam. Approximate depth 12 to 20 inches.
Sagebrush	Big Sagebrush - occurs below below the elevation range of the mountain shrub and aspen.	Clay loam. Approximate depth 6 to 12 inches
	Big Sagebrush - Smooth Browse - appear in areas that have been part of the Aspen community years ago.	Loam to sandy loam, approximate depth 14 to 18 inches.
	Silver Sagebrush - occurs in areas similar to big sagebrush.	Clay to clay loam, approximate depth 4 to 12 inches.

Vegetative types	Subtype	Soils
Sagebrush (continued)	Low Sagebrush - occupies a small area within the lowest elevations in the study site.	Clay, approximate depth shallow.
Grass	Mules Ear - Western Wheatgrass - occupies a small area between the aspen and mountain shrub subtypes.	Clay to clay loam.
Meadow	Wet Meadow - the bottom land around Foidel Reservoir No. 1 and adjacent stream beds.	Clay to clay loam approximater depth 6 to 12 inches.
	Dry Meadow - surrounded by aspen and mountain shrub subtypes.	Similar to those of the surrounding area.

Wildlife Habitat

Mule deer and elk occupy the study site in varying densities depending upon the condition of the food and cover, degree of harassment, and severity of winter. Black bear and couger are found in the area but are relatively few in number.

The study site provides marginal winter habitat and fair to good summer browse habitat for deer. Cover is provided by a combination of brush, aspen, and topography and appears to be adequate to meet the needs of the local deer. Water also appears to be of sufficient quality and quantity to meet their needs. Water is provided by Foidel and Middle Creeks and several scattered ponds or stock tanks. Important deer foods found within the study area are serviceberry, snowberry, bitterbrush, oak, common chokecherry, and big sagebrush.

The study site provides good elk winter habitat. Wintering elk appear to concentrate along Middle Creek and Rattlesnake Butte as well as in and around the old spoils of the Energy Fuels Mine No. 1 just east of the study site. Elk do migrate through the area and a calving ground is located at the south end of Section 24. Cover is provided by aspen and mountain shrub and by various topographic features. Spoil piles may provide some protection from severe winter weather. Cover appears to be adequate to meet the elk's needs. Water does not appear to be a limiting factor on the elk population. Adequate water exists on the study site in the form of snow, scattered ponds, stock tanks, and the creeks running through the area.

VISUAL RESOURCE

The study area is made up of sagebrush minimal relief, aspen, and mountain shrub-steep slopes landscape types (or scenic quality rating units). All the scenery classes in the Foidel Creek Study Site fall into the B scenery class, which is average scenery quality. The sagebrush minimal relief landscape type has a scenic quality rating of B. All of the land area within this type has a low level of sensitivity. The aspen landscape type has been rated as B scenery and has a low sensitivity level. The mountain shrub-steep slopes type has a B scenic quality rating and a moderate level of sensitivity.

RECLAMATION POTENTIAL AND ALTERNATIVES

The Postmining Land-use Objective

The surface lands in the Foidel Creek Study Site are primarily used for wildlife grazing and habitat, domestic livestock grazing, and watershed management. The objective will be to reclaim the area after mining to its present uses. As an alternative to restoring the land to its present land use array, the possibility of dryland wheat production should be considered. Areas within the reclamation site could be adapted to farming if the final land shape is sufficiently leveled to permit farm machinery use and if topsoil plus subsoil are restored.

Summary of Reclamation Problems and Recommended Measures

Based on the land suitability survey, it is expected that approximately 91 percent of the study area has adequate material for postmining reclamation purposes. The remaining 9 percent of the study area are lands which have soil and topographic deficiencies and drainage characteristics which render them unsuitable. Based on the characterization of surface and upper soil materials made in relation to the land suitability survey, soils in the study area will reflect few adverse physical or chemical conditions when used as plant growth media. The majority of the surface soils are fine sandy loams, sandy clay loams, and clay loams with adequate permeabilities and water holding capacities and exhibit low levels of alkalinity and salinity. Based on the five deep core holes, much of the overburden material (5 feet to bottom of coal seam) was identified as suitable and is generally well suited for use as planting media. However, since sufficient topsoil is available, overburden material will not be considered as a source of planting media.

Assuming proper site preparation measures are taken, successful revegetation should be achieved based on the quality and quantity of planting media evaluated in the Foidel Creek Study Site. Nitrogen and phosphorous fertilization is recommended; however, more detailed fertility studies should be undertaken in this area before specific application rates can be recommended. Neither salinity nor alkalinity contents are of the magnitude to be toxic in the material selected as planting media. More detailed studies should be conducted by the lessee prior to preparing a mining plan to determine whether or not toxic elements, such as boron, selenium, and heavy metals exist in the area that will be detrimental to revegetaion, surface and ground-water supplies, and animal consumption. Precipitation is adequate for spring and early summer revegetation efforts; however, soil water may be limiting to fall planting of trees and shrubs. Winter temperatures, particularly when snow cover is absent, may be detrimental to recently established vegetation.

Mining will result in increased suspended sediment concentrations at first, but these concentrations will decrease over time during the reclamation period. Erosion and sediment hazards are particularly high in and near valley alluvium and stream channel areas because of the fine-grained material found there. Direct disruption of channels will result in fine-grained sediment being transported considerable distances downstream. Where precipitation is transmitted through spoil materials and into the ground-water system, dissolved solids concentrations will increase on the recession end of the hydrograph. Stream baseloads will have higher dissolved solids loadings. Total dissolved solids concentrations will decrease slightly over time as the permeability of spoils decreases. Some dewatering may be necessary, depending upon the exact location and design of the mine with respect to the potentiometric surface. Quantities of water are not expected to be great; the existing channels should be able to handle the additional water. Mining activities are not expected to significantly increase flood potential and/or damage. Any suitable topsoil that is stockpiled should be identified and kept separated from unsuitable materials so that contamination can be kept to a minimum. Bedrock materials that are identified unsuitable should be separated and later placed at a depth of at least greater than 10 feet below the reconstructed soil profile. Primary consideration in the placement of the unsuitable bedrock material should be given to prevention of pollution of ground waters or contamination of surface waters. Mining activities will be kept out of the flood plains of Foidel and Middle Creeks. In addition, buffers should be installed between the mine and these main channels to prevent any sediment from reaching their waters. Tributary streams should be completely impounded or rerouted above the minesite. Should any first order tributaries to Foidel Creek be mined, the reclamation plan should include returning these streams to their original hydraulic characteristics. The use of water control structures is acceptable and recommended. They should not be used for water retention where subsequent percolation will increase dissolved solids concentrations. Large sediment basins should be located below spoils piles rather than in them.

All water and erosion control structures should be designed so as to limit their effective life to not greater than 10 years and not less than 5 years. Following the reclamation period, remaining water or sediment control structures should be removed. Reconstructed slopes should resemble premining conditions. Long slope segments over 4 to 5 percent should be interrupted by terraces. Slope segments between terraces should not exceed 50 to 100 feet in length depending on the slope steepness. Wherever possible, south exposures should be minimized and graded relatively flat so as to lessen the microclimate effects on revegetation. From a visual resource standpoint, the reclamation-end results should borrow lines, colors, textures, and forms from the original and surrounding landscape elements. To improve infiltration, chiseling of the topsoil prior to planting is recommended. Also, on slopes over 2 percent, gouger pitting and/or contour furrowing is recommended. Again, any erosion control structures should have an effective life of between 5 and 10 years. Reclamation efforts should be directed toward the development of diverse and self-perpetuating plant communities. Initial efforts should be aimed at establishing a suitable watershed cover so as to stabilize the soil surface composed of native and some introduced grasses. A good cover of grasses is necessary to initiate and support nutrient cycling. Fall seeding of grasses is recommended for the Foidel Creek Study Site. Fertilizer mixtures should be incorporated into the soil before or during seeding. For a quick establishment of wildlife cover, the establishment of trees and shrubs through transplanting is recommended. The transplanting of mature healthy stock can be accomplished with use of a front-end loader and/or tree spade. To ensure success of transplanting of shrubs and trees, planting sites should be selected carefully. Microclimate pockets, north aspects, and areas of snow accumulation, or areas where water accumulates during wet seasons are good transplant sites. High density plantings should be avoided in order to reduce competition for water and other nutrients; however, seeding rate should be high enough to discourage weed species from establishing.

Postmining Land Management During Reclamation

In the event weed growth prevents the likely survival of the seeded species during establishment, acceptable methods of weed control should be used. Reseeded areas should be protected from grazing for a minimum of 3 years until vegetation is sufficiently developed and established to withstand grazing use without damaging the vegetative cover. Once established, the planned grazing system should be used to graze the area. It may be necessary to reintroduce shrub and tree transplants for additional wildlife cover and food.

Alternatives for Reclamation

Although it is assumed that the entire area will be reclaimed for wildlife grazing and habitat, domestic livestock grazing, and watershed management use following mining, the possibility of dry land wheat production should be mentioned. Areas within the reclamation site could be adapted to farming if the final land shape is sufficiently leveled to permit farm machinery use and topsoil plus subsoil are restored. Such use would produce more food for human consumption than is possible from native vegetation.

BUREAU OF LAND MANAGEMENT
Library
Denver Service Center

RROWER'S CARD
OWER
OFFICE
DATE RETURNED
(Continued on reverse)

BLM LIBRARY
SC-324A, BLDG. 50
DENVER FEDERAL CENTER
P. O. BOX 25047
DENVER, CO 80225-0047